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(54) ASPHALT CEMENTS

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IMPROVEMENTS IN ASPHALT CEMENTS

ABSTRACT OF THE DISCLOSURE

The viscosity of asphalt is improved by incorporating between 1% and 12% by weight of kraft soap skimmings within the asphalt which has been heated to a temperature of between 200°F and 350°F and then stirring and agitating the soap skimmings until substantially all of the water contained within the soap skimmings, has been removed by evaporation.

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IMPROVEMENTS IN ASPHALT CEMENTS

BACKGROUND OF THE INVENTION

This invention relates to new and useful improvements in asphalt cements or asphaltic materials, and in particular to those which are used as the binder in paving compositions.

Bituminous pavements have had a history of approximately one hundred years. Volume 43A of the Proceedings of the Association of Asphalt Paving Technologists presents an historical review of the industry. After the year 1950 the rapid increase in traffic volume, and the increase in load carrying capacity of trucks, predicated a re-evaluation of road building methods and materials. In particular the asphalt binder for pavement construction became the object of serious study, and by 1960 it had become evident that viscosity of the binder was an indication of asphalt quality. Thus emerged the concept of viscosity grading of asphalt cements, in conjunction with, or replacing, the earlier method of penetration grading. Typical requirements for these classifications are illustrated in ASTM Standard Specification D946-74 and D3381-76.

Studies in the 1970's have proved that high viscosity asphalts (for a fixed penetration value) produce pave-

ments which are more durable than those produced with binders of low viscosity. In particular pavements constructed with high viscosity asphalts are more resistant to thermal stresses induced by climatic fluctuations (especially sudden severe drops in temperature). A typical study undertaken in Manitoba, Canada, was reported on in the Proceedings of the Canadian Technical Asphalt Association, Volume XIX, P. 45 by Gaw, Burgess and Young.

However, crude sources from which high viscosity asphalts can be obtained are limited in number. This heavy crude is moreover difficult to transport in the pipeline systems, and its refining can only be undertaken at lower through-put and loss of other marketable lighter petroleum products. Thus the bulk of asphalt which is produced is from lighter crudes, resulting in asphalts of varying quality, from medium viscosity to low viscosity.

Many people have invented compositions of asphalt and other materials to improve the quality of the resulting pavement. Improvements in paving asphalt have been made by emulsifying them, and incorporating the emulsified asphalt into the paving mixture either by a hot or cold process. However, these processes have all measured their relative improvements in quality, by methods other than measurements of viscosity of the asphalt composition.

SUMMARY OF THE INVENTION

This invention improves asphalt used as the binder for paving composition by increasing the viscosity of the asphalt cement, where such viscosity measurements, as defined in current test methods, and in the literature have indicated an improvement in quality. This process also changes the rheological properties of the asphalt from Newtonian to non-Newtonian. The latter property permits thicker films of asphalt to be applied and retained on open graded aggregate mixture.

In accordance with the invention there is provided an asphalt for use in road surfacing and the like comprising in combination asphalt at a temperature of between 200°F and 350°F and from 1% to 12% by weight of kraft soap skimmings containing approximately 55% by weight of resin and fatty acids as sodium salts and approximately 10% by weight of black liquor solids.

In accordance with a further aspect of the invention, there is provided a method of improving the viscosity of asphalt consisting of the steps of heating the asphalt to between 200°F and 350°F and then incorporating therein between 1% and 10% by weight of kraft soap skimmings, said soap skimmings containing approximately 55% by weight of resin and fatty acids as sodium salts and approximately 10% by weight of black liquor solids.

With the foregoing in view, and other advantages as will become apparent to those skilled in the art to which

this invention relates as this specification proceeds, the invention is herein described by reference to the accompanying drawings forming a part hereof, which includes a description of the best mode known to the applicant and of the preferred typical embodiment of the principles of the present invention, in which:

DESCRIPTION OF THE FIGURES

Figure 1 is a graph relating to the viscosity and shear rate.

DETAILED DESCRIPTION

Proceeding therefore to describe the invention in detail, the additive material used in this process is kraft soap skimming, also known as sulphate black liquor skimmings. In the sulfate or kraft process, chipped pine wood is digested with a solution of sodium sulfide, Na_2S, sodium hydroxide, NaOH, and sodium carbonate, Na_2CO_3. The digestion proceeds, under high temperature and pressure, in a vessel called a digester. During the digestion or pulping process, the cellulose fibers are released from other wood constituents. The highly alkaline solution, or "white liquor", used in the digestion process forms soluble sodium salts of the lignin, the resin, and the fatty acids, the fatty acids originally having been present as esters. The soaps and spent cooking liquor are washed from the wood pulp

by water, and this wash solution is added to the black liquor which separates from the pulp as the entire mass is blown from the digester into the blow pit or receiving tank. The black liquor and the soap solution washed from the pulp are concentrated in multiple effect evaporators to about 15% to 50% by weight as solids. As the total solids content of the black liquor is increased by the process of evaporation, the soap rises to the surface of the liquor. Separation is aided by cooling. The soap is skimmed mechanically from the surface of the black liquor. The soap skimmings contain approximately 55% by weight of resin and fatty acids, as sodium salts, 35% by weight of water, and 10% by weight of black liquor solids, but in some instances water content may be as high as 55% by weight. It should be appreciated that the percentages are approximate.

METHOD

This improvement in viscosity can be achieved by incorporating into the asphalt from between 1% to 12% of kraft soap skimmings, which is a by-product of the kraft pulp process. The skimmings are introduced into the asphalt while the asphalt is hot (200°F- 350°F) and the mixture subjected to stirring and agitation until all the water contained in the skimmings has been removed by evaporation.

Alternately, the kraft soap skimmings can be

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incorporated into a bituminous gel, for use in making a paving composition, as described in Canadian patent 914857.

EXAMPLES

A number of asphalts derived from various crude sources, and as refined by various refineries, were treated with kraft soap skimmings according to the method described above. The following examples illustrate the results of treating asphaltic materials according to this invention:

Example 1

An asphalt manufactured from South Saskatchewan crude by the Gulf Canada refinery at Moose Jaw was treated according to the invention. Viscosity improvement is shown in the following table:

Asphalt Source	Percent Skimmings Added	Percent HVGO	Penetration at 77°F	Absolute Viscosity Poise	Shear Rate Sec^{-1}
Gulf M.J. 150/200	0	0	185	446	23.1
"	1	0	167	477	21.5
"	2	0	131	629	17.5
"	3	0	122	1,600	1.0
"	4	0	113	3,292	2.1
"	6	0	107	29,799	0.23
"	5	2	110	3,420	1.0

Viscosity values determined by ASTM method D2171 using Cannon

Manning tubes, except for the 3% addition for which viscosity values were measured with a modified Koppers tube. Results are illustrated on Figure 1.

Example 2

An asphalt supplied by Big West Oil Co. from a refinery at Cut Bank, Montana, U.S.A. was treated with kraft soap skimmings as described in the process. Viscosity was increased as shown in the following table:

Asphalt Source	Percent Skimmings Added	Percent Diluent	Penetration at 77°F	Viscosity Poise at 140°F	Shear Rate Sec^{-1}
Cut Bank 85/100	0	0	96	666	-
"	0	3	126	470	1.0
"	2	3	86	1,140	1.0
"	4	3	92	2,350	1.0
"	6	3	77	3,960	1.0

Example 3

As asphalt designated AC 27.5 as supplied by Imperial Oil Co. from the Edmonton, Alberta, refinery as processed from a blend of Red Water and Cold Lake crudes, was treated with 6% kraft soap skimmings by the described process.

Asphalt Source	Skimmings Added	Penetration at 77°F	Viscosity Poise at 140°F	Shear Rate $_{Sec}^{-1}$
Imperial AC 27.5	0	256	421	-
"	6	133	3,200	1.0

Example 4

An asphalt manufactured by the Shell Refinery in Winnipeg, Manitoba, from light sour blend crude from southeastern Saskatchewan, was treated with kraft soap skimmings by the above process. Viscosity increases associated with this treatment are as follows:

Asphalt Source	Percent Skimmings Added	Percent Diluent	Penetration at 77°F	Viscosity Poise at 140°F	Shear Rate $_{Sec}^{-1}$
Shell,Wpg. L.S.B.	0	0	184	276	-
"	0	3	281	144	1.0
"	2	3	176	1,000	1.0
"	4	3	180	3,030	1.0
"	6	3	178	9,200	1.0

Example 5

An asphalt supplied by the Gulf Canada refinery at Kamloops, B.C. as manufactured from Alberta Red Water crude, was treated with kraft soap skimmings by the above process.

Asphalt Source	Percent Skimmings Added	Percent Diluent	Penetration at 77°F	Viscosity Poise at 140°F	Shear Rate Sec^{-1}
Gulf K 85/100	0	0	95	705	-
"	0	3	267	433	1.0
"	2	3	108	1,500	1.0
"	4	3	74	7,380	1.0
"	6	3	94	19,300	1.0

Example 6

A blend of 2 parts 85/100 penetration asphalt and 1 part No. 2 fuel oil were combined. The viscosity of this combination when tested at 140°F was 157 centistokes. This asphaltic blend was combined 4:1 with a water solution containing 6.6% kraft soap skimmings (based on weight of asphalt and oil) through an emulsion mill. The resulting gel was tested according to ASTM Standard Method D244, on a residue obtained by distillation. This bituminous material remaining had an absolute viscosity value of 452 poise at a shear rate of 1 sec^{-1}.

The change of viscosity values with shear rate illustrates the non-Newtonian nature of the processed bitumen.

Viscosity Poise at 140°F	Shear Rate Sec^{-1}
358	3.33
354	2.24
336	1.71

441 1.08

When subjected to flow test this material exhibited a limiting yield stress, although the limiting value was not determined.

Since various modifications can be made in my invention as hereinabove described, and many apparently widely different embodiments of same made within the spirit and scope of the claims without departing from such spirit and scope, it is intended that all matter contained in the accompanying specification shall be interpreted as illustrative only and not in a limiting sense.

CLAIMS:

(1) An asphalt for use for surfacing purposes comprising in combination asphalt at a temperature of between 200°F and 350°F and from 1% to 12% by weight of kraft soap skimmings containing approximately 55% by weight of resin and fatty acids as sodium salts and approximately 10% by weight of black liquor solids.

(2) A method of improving the viscosity of asphalt consisting of the steps of heating the asphalt to between 200°F and 350°F and then incorporating therein between 1% and 10% by weight of kraft soap skimmings, said soap skimmings containing approximately 55% by weight of resin and fatty acids as sodium salts and approximately 10% by weight of black liquor solids.

(3) The method according to Claim 2 which includes the additional step of incorporating the soap skimmings within the asphalt by stirring and agitation until the water content of the soap skimmings is removed by evaporation.

(4) The method according to Claim 2 which includes the additional step of first incorporating the soap skimmings into a bituminous gel.

(5) The method according to Claim 3 which includes the additional step of first incorporating the soap skimmings into a bituminous gel.

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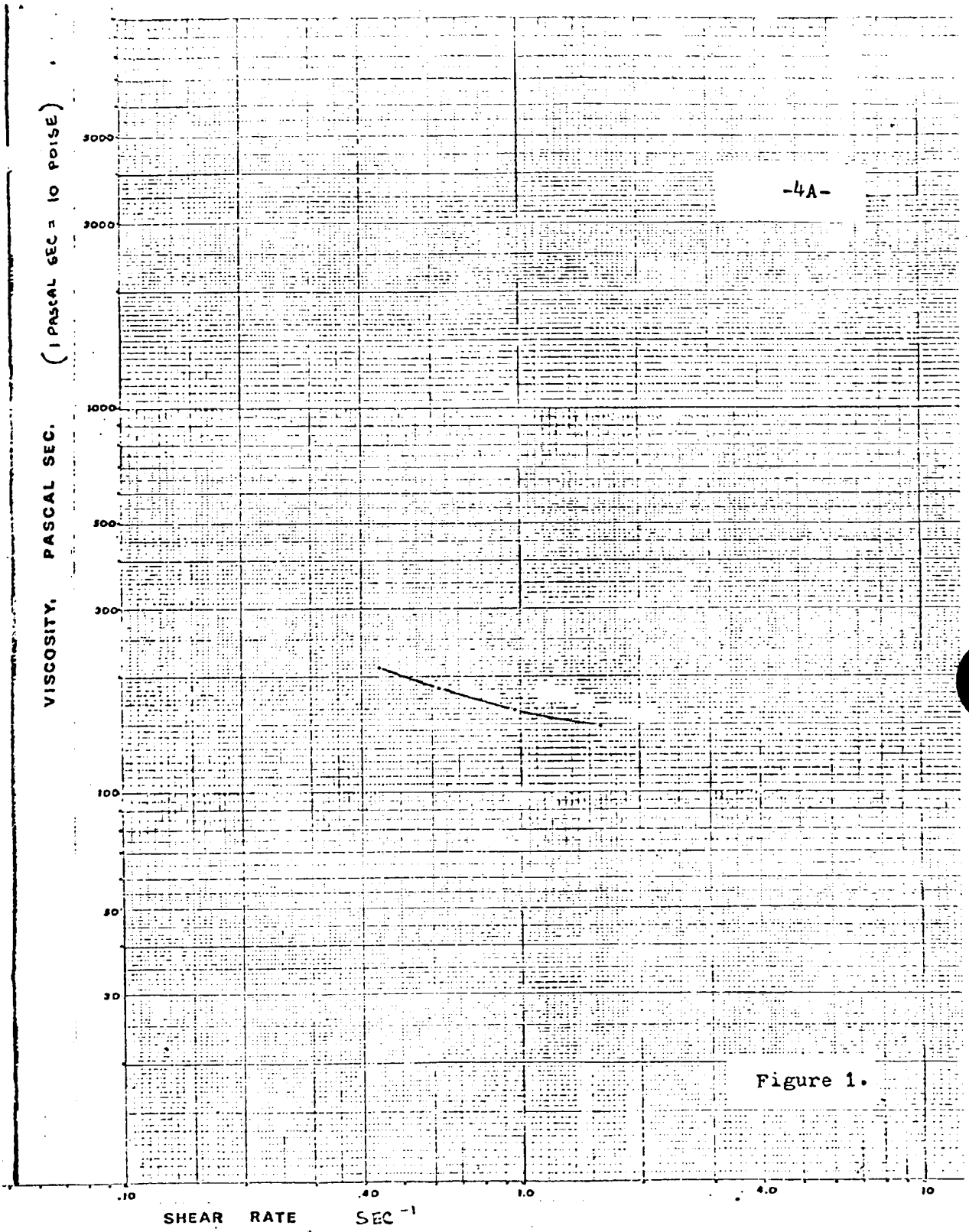

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Figure 1.

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